Decade Length of Day Changes During the 18th Century

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Decade changes in the length of the day (lod) are thought to originate in the Earths core. Core flow is variable on a time-scale comparable to lod, and changes in the westward drift of the magnetic field generated by the flow over the last century are consistent in sign and magnitude with the decade oscillations of the mantle spin rate. Although the nature of the coupling between the core and mantle remains unknown, a comparison between the relative angular momentum changes each has experienced since about 1840 reveals a strong similarity (provided flow deep inside the core obeys certain simplifying assumptions).

Estimates of lod based on lunar occultations are also available for periods earlier than 1840 dating back to about 1630. These early estimates lack the precision (and perhaps accuracy) of the more recent values, but their estimated uncertainties are not large enough to obscure variability like that seen during the 20th century.

The salient feature of the lod data during the 18th century is the absence of short-period, even decadal, fluctuations. This is remarkable in view of the persistent and often large decade-scale changes that mark the data after that date. *Munk and Macdonald* [1960] first called attention to this unusual feature branding it an enigmatic phenomenon.

What might explain the pronounced difference in the nature of the lod signal that takes place near 1780? If decadal lod is indeed a faithful proxy for core angular momentum, and the 18th century lod values are reliable, then it suggests the core flow carrying that momentum changed significantly starting at about 1780. What could have happened at that time? It may be that the lod data before 1780 cannot be trusted, or, perhaps somehow the core and mantle only became strongly coupled to one another starting about 220 years ago. In an attempt to resolve this puzzle we estimate core angular momentum (CAM) over a 300 year time span to compare with the lod series since about 1690. We find that our CAM series extends its relatively good correlation with the lod data from 1840 back to about 1780. However, while the lod series flattens over the period prior to 1780 evincing no decade variations, the CAM series displays an oscillatory behavior similar to that evident during more recent times.

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